KYTC STATEWIDE DRAINAGE DESIGN

- Provide Drainage Design Services on an as needed basis:
  - Perform hydraulic analysis for storm sewers, culverts, bridges and detention/retention basins. Develop drainage folders for highway projects, etc.
  - Assist KYTC with FEMA compliance on highway projects.
Arch, Semi-circle, Conspan

Box

Circular

Concrete

Concrete

RCP, CMP
KYTC Statewide Drainage Design

- Structure Slope
- Configuration
  - Wingwalls/Headwalls
  - Pier orientation
  - Pipe orientation
- Scour and Scour Countermeasures
### Table 402-1, Return Intervals for Drainage Analysis

<table>
<thead>
<tr>
<th>Structure</th>
<th>ADT Limits</th>
<th>Return Interval (years)</th>
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</thead>
<tbody>
<tr>
<td><strong>Bridge Size Structure (Span ≥ 20')</strong></td>
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<tr>
<td>ADT &lt; 400</td>
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<td>400 &lt; ADT ≤ 2,000</td>
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<tr>
<td>2,000 &lt; ADT</td>
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<td>Interstate</td>
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<tr>
<td><strong>Culvert or Lateral Storm Sewer in a Sag</strong></td>
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<td>Interstate</td>
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<tr>
<td><strong>Bridge Scour Analysis</strong></td>
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<tr>
<td>Storm Sewer</td>
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<tr>
<td>Inlet Spread</td>
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<tr>
<td>Channel Change</td>
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<tr>
<td>Roadway Ditch capacity / Ditch Lining shear</td>
<td></td>
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<tr>
<td>Drop Inlet</td>
<td></td>
<td></td>
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<tr>
<td>Detention or Retention Basin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Analysis</td>
<td></td>
<td></td>
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<tr>
<td>No Impact Certification</td>
<td></td>
<td></td>
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<tr>
<td>Letter of Map Revision (FEMA)</td>
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</tr>
</tbody>
</table>

(1) If the overtopping storm is less than the 100 year storm (1%), it should be used as the design storm to calculate scour.

(2) Storm sewer pipes which drain at sag points where runoff can only be removed through the storm system should be designed for a 25-year storm (4%). Storm Sewers on interstates should be checked to ensure that the hydraulic grade line resulting from the 50 year storm (2%) does not surcharge into the roadway.

(3) Pavement inlet spacing spread calculations shall be based on four (4) in/hr Rainfall intensity.
Curry’s Branch Road Bridge Replacement

– Located in a Zone A Special Flood Hazard Area
  • No BFEs established
  • No Floodway
– Project proposed due to:
  • Poor roadway geometry
  • Frequent flooding
– Site Conditions
  • Drainage Area of 14 square miles
  • Fairly high relief; Low stream slope (<0.1%)
## Curry’s Branch Bridge Replacement

<table>
<thead>
<tr>
<th>Existing Bridge</th>
<th>Proposed Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Overtopped by &lt; 2-yr flood</td>
<td>• Passed 25-yr event</td>
</tr>
<tr>
<td>• Bridge is overtopped frequently</td>
<td>• 4% annual chance</td>
</tr>
<tr>
<td>– Greater than <em>50% chance</em> of occurring every year</td>
<td>• Trade-offs</td>
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<tr>
<td></td>
<td>– Increased flood elevations U/S of bridge</td>
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<tr>
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<td>– CLOMR</td>
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</tbody>
</table>
• CLOMR
  – Conditional Letter Of Map Revision
    • FEMA’s comment on a proposed project affecting SFHAs

  – Affects to a SFHA considered:
    • Greater than 1’ rise to existing 100-yr floodplain:
      – Zone A’s and Zone AE’s with no floodway established
    • Greater than 0’ rise to existing 100-yr floodplain:
      – Zone AE’s with a floodway established
ZONE A OR ZONE AE w/o FLOODWAY ESTABLISHED

A CLOMR is required if proposed drainage structure causes 100-yr to have >1 ft of increase
• No Structures Impacted Certification
  – (44 CFR 65.12) “(5) Certification that no structures are located in areas which would be impacted by the increased base flood elevation.”

  – Property already located in the SFHA cannot be affected by area of flood elevation increase

  – No new property affected by area of flood elevation increase
ZONE A OR ZONE AE W/O FLOODWAY ESTABLISHED

A CLOMR is required if proposed drainage structure causes 100-yr to have <1 ft of increase
• CLOMR Cont’d
  – Concurrence from Clay County Floodplain Coordinator, David Watson.
  – Legal Notice to Property Owners explaining impact of proposed action.
    • Can be relevant to uninsurable property or possibly access points
  – LOMR to be submitted to FEMA and Community after construction
Tradewater River
KY-293/Barnes Store Road
Caldwell / Hopkins County Line
KY-293 Bridge Replacement at Tradewater River

- Located in a Zone A Special Flood Hazard Area
  - No BFEs established
  - No Floodway
  - No CLOMR if increases to 100YR WSELs < 1 ft
  - $400 < ADT < 2,000 => Must pass 25-YR

- Site Conditions
  - Drainage Area of 363 square miles
  - Low relief; Low stream slope (~0.03%)
  - Flat and wide floodplain with multiple flow paths
KY-293 Bridge Replacement at Tradewater River

**HEC-RAS 1D**
- Steady-State
- Unsteady-State
  - Can Model:
    - Bridges
    - Culverts
  - Single Flow Paths
  - Products:
    - Profiles
    - Tables

**HEC-RAS 2D**
- Unsteady State
  - Can Model:
    - Culverts
    - Not Bridges
  - Multiple Flow Paths
  - Products:
    - Elevation, Depth, & Velocity Grids

**HEC-RAS Coupled 1D/2D**
- Unsteady State
  - Can Model:
    - Bridges
    - Culverts
  - Multiple Flow Paths
  - Products:
    - Profiles & Tables
    - Elevation, Depth, & Velocity Grids
KY-293 Bridge Replacement at Tradewater River

- Passes 25YR flood
- Proposed Bridge resulted in a reduction to 100YR flood elevations
  - No CLOMR/LOMR
  - No need to coordinate with local Floodplain Managers or FEMA
FLOODPLAIN MANAGERS AND KYTC

• What role can local Floodplain Managers play in the process?
  – Reach out and create a working relationship with KYTC District staff
    • 12 KYTC Districts covering Kentucky
  – Be aware that KYTC regularly conducts projects on road infrastructure to mitigate flood and emergency access risks.
  – Check out KYTC Active Highway Plan: http://maps.kytc.ky.gov/photolog/?config=ActiveHighwayPlan